Surgical case scheduling under generalized resource constraints

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The operating theatre (OT) is an important resource in any hospital. Surgery related services can represent more than 40% of hospital costs and revenues [1]. Consequently, a significant amount of attention is devoted to ensuring that this service is provided as efficiently and cost-effectively as possible. Managing and operating an OT is complex, requiring coordination of human and material resources, equipment and logistics. Careful scheduling is necessary to avoid delays and ensure high throughput.

This study presents a decision support model and algorithm for scheduling an OT. The model aims to support OT managers in their daily/weekly task of both scheduling (determining the date and time of) surgeries and assigning them to an operating room. This process generally differs between hospitals due to differences concerning infrastructure, policies and agreements with surgical staff. Therefore, this study emphasises the development of an adaptable general approach which may be customized for individual hospitals as required. One key contribution is the introduction of generalized resource dependencies that account for a variety of different resources, both human (surgeons, anaesthesiologists, instrumenting nurses) and material (portable imaging tools, operating lights). A lexicographic objective function models several performance indicators concerning the efficiency of the OT in addition to violations of (soft) resource constraints and personnel preferences.

A two-phase heuristic approach is presented which solves this decision support model [2]. This heuristic employs a schedule generation procedure within a local search algorithm to find high-quality solutions in a limited time. The approach has been implemented as a prototype in the OT management software product 'QCare OR', developed by Dotnext[1]. An experimental study on this approach was conducted using real-world data from a Belgian hospital and the subsequent successful results demonstrate the model's practical applicability and optimization potential.

Acknowledgement: This work was supported by the Belgian Science Policy Office (BELSPO) in the Interuniversity Attraction Pole COMEX and funded by both a Ph.D. grant and research project 120604 of the Institute for the Promotion of Innovation through Science and Technology in Flanders (IWT-Vlaanderen).

[1] http://www.dotnext.be

References

[1] Alex Macario, Terry S Vitez, Brian Dunn, and Tom McDonald. Where Are the Costs in Perioperative Care? *Anesthesiology*, 83:1138–1144, 1995.

[2] Wim Vancroonenburg, Pieter Smet, and Greet Vanden Berghe. A two-phase heuristic approach to multi-day surgical case scheduling considering generalized resource constraints. *Operations Research for Health Care*, 7:27–39, 2015.